Original Research Article

EVALUATION OF AGRONOMIC TRAITS AND PROCESSING TRAITS IN TEN VARIETIES OF POTATO (*Solanum tuberosum L.)* IN JOS-PLATEAU STATE, NIGERIA.

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ABSTRACT

Potato (*Solanum tuberosum* L.) has become an important food crop in Sub-Saharan Africa. Its high yields, relatively shorter growth cycle (90-120 days) compared to other food crops, and nutritional properties make it an important crop in the quest for food security in Sub-Sahara Africa. The experiment was conducted to evaluate the best potato varieties for chips. Ten potato (*Solanum tuberrosum*) varieties; Nicola, China Var, Mandola, Caruso, Yellow, Delice, SP and Famosa obtained from the National Root Crop Research Institute (NRCRI), Kuru, Jos, Plateau state, Nigeria were evaluated for their processing (chips) and agronomic quality attributes. To determine the chips quality, the harvested tubers were peeled, sliced to a thickness of 2 mm and deep fried in vegetable frying oil at initial temperature of 180^0C for 4 min. sensory evaluation was conducted for colour, taste and crispiness. The result showed that there were significant differences among the varieties in chip quality except for crispiness. Marable, Nicola, Caruso, Condor, China Var, and Famosa had the best tuber quality for chip processing.

Keyword: Chips, Crispiness potato, *Solanum tuberosum*, Evaluation

INTRODUCTION

Potato (*Solanum tuberosum L.*) is considered a native to Central and South America, mainly to the highland plains ('puna') and Andes Mountains between 40°N and 45°S but has been introduced to most parts of the world. Potato (*Solanum tuberosum* L.) has become an important food crop in Sub-Saharan Africa. Its high yields, relatively shorter growth cycle (90-120 days) compared to other food crops, and nutritional properties make it an important crop in the quest for food security in Sub-Sahara Africa. The edible portion of

potato contains carbohydrate (66%), protein (1.9%), fat (0.1%), water (77%), fibre (1.8%), potassium (5%), besides minerals and vitamin like vitamin A (FAO, 1991). The combination of carbohydrate, fat and fibre makes the potato a valuable food and feed.

In Nigeria, products from potato such as potato chips are consumed by both the rich and the poor. The potato is ranked fourth most important staple crop after cassava, yam, and sweet potato. Besides it nutritional attributes, the crop holds a strong economic potential and can be financially rewarding to the farm economy. The crop is also use in the treatment of disorders such as chronic constipation, intestinal toxemia, gout, kidney stones, scurvy, arthritis and digestive system problem (Umadevi *et al*., 2013). In the international market, potato is believe to be more economically important in tropical Asia, Europe, particularly in India where it is produce as a wafer (Anon, 2013). The growth and development of the potato and the production of potato chips as one of the beneficiary products of potato, is believed to have contributed to the nutritional value, increased income as well as reduction of food crisis at the household level (FAO, 1991). The objective of this study was to evaluate the agronomic traits and processing traits in ten varieties of potato in Jos, Plateau State, Nigeria.

MATERIALS AND METHODS

The study was carried out at the National Root Crop Research Institute (NRCRI), Kuru, Jos-Plateau State (Latitude $09^0$44N, Longitude $08^0$48E. Altitude 1350 m above sea level). The ten varieties of the potato were sourced from the National Root Crops Research Institute (NRCRI), Kuru and some from local farmers in Plateau state. These include Nicola, China Var, Mandola, Caruso, Yellow, Delice, SP and Famosa.

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Ridges for this experiment were made at the research farm of the National Root Crops Research Institute, Kuru, Plateau state. The total farm site (Plot) for this study was 6m (3x2) and planting was done at an intra-spacing and inter-spacing of 30x100cm respectively in a Randomized Completely Block Design (RCBD) with four replications, one of the replicates was used for the growth analysis study. N.P.K (15.15.15) fertilizer was applied two weeks after planting.

Field observation and data collection commenced 4 weeks after planting (WAP) and continued bi-weekly until harvest. The emergence rate was computed as the ratio of the number of tubers that emerged out of the total number planted and multiplied by 100.

$$\text{Emergence} = \frac{\text{Number of plants that emerged}}{\text{Total number of tubers planted}} \times 100$$

Five (5) plants were sampled per plot at random in each plot for measurements. The mean of sample plants were used as a plot mean for analysis. Data was taken on growth parameters, such as Plant heights @ 60DAP, Emergence count @ 4WAP, Number of stem @ 60 DAP, Plant canopy, Internode length, stem girth, and while the harvest were taken on: number of leaves at harvest, number of saleable tuber, weight of saleable tuber, number of unsaleable tuber and weight of unsaleable tuber.

The total number of tubers harvested in each plot was divided by the number of plant stands at harvest to obtain the mean number of tubers per plant. All the tubers harvested from each plot were weighed and the weight was divided by the total number of tubers from respective plot in order to obtain the mean tuber weight for each varieties. The mean tuber weight was used for the statistical analysis. Five plants were sampled from each plot the stem girth was measured at the stem diameter. The mean stem girth was used for the

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statistical analysis. 5kg from the total harvested tuber was measure in air and in water for specific gravity to determine the absorption rate and also to determine the flavor and taste of each variety using the following formula

Specific gravity = a/(a-b); where, a is weight in air and b is weight in water.

1.5kg of fresh tuber sample was taken from the harvested tubers, weighed and was peeled and put into an oven at 100^0c for 48 hours. After cooling, the dry matter percentage was computed as follows: DM% = $\frac{b}{a}$ x 100

Where**,**

a = Fresh weight of sample

b = Dry weight of sample

All tubers harvested from each plot were weighed. The weight was converted to the equivalent in tones per hectares.

The harvested potatoes tubers were thoroughly washed to remove all traces of dirt and soil. The Potatoes were peeled by hand using a sharp knife and manual peeler. Abrasive potato peelers are available. Lye peeling is also an option for larger scale operations. After peeling, the potatoes were submerged in clean water until ready to use to prevent blackening. Potatoes were sliced as thinly as possible using a sharp knife or a slicing machine. The slices were of a uniform thickness to ensure that they were all cooked at the same rate. Potato slices of 1.2 to 1.5 mm thick were prepared as per procedures described by Lisinka *et al*. (2007). Before frying, the frying oil was heated for about 15 minutes at the required temperature of180 ± 5°C which was measured using thermometer. The slices were fried using a fryer for about five minutes until the bubbling ceases and all experiments were carried out in three replications.

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Sensory evaluation was performed on potato chips. They were fried using sunflower oil. Organoleptic evaluation of chips was carried out for each variety at each location. A 10 member panelists were voluntarily selected to rate the quality attributes. Prior to the sensory tests, the panelists were given orientation for a short period of time which was supposed to help them in evaluating the attributes of the chips (Watts, *et al.,* 1989). A 5-point hedonic test was used to measure taste (sourness, bitterness, saltiness and sweetness), color, texture and crispness (Kita, 2002). A 9-point hedonic test was employed to assess flavour and overall acceptability of chips according to Yost *et al*, (2006).

The potato chips from each variety was coded with three-digit codes, placed randomly in coded plates (plastic trays) and served to each panelist. Water was provided to the panelists to rinse their mouth before and between testing samples as suggested by Watts *et al.* (1989) and the evaluation were repeated 3 times for each sample. Supervisors were placed in different places to avoid communication among panelists during the evaluation and to give them short and precise description how to score chips for taste, texture, appearance, color, flavor and overall acceptability (Kita, 2002). Crisps were removed from the hot oil, drained on an absorbent paper to remove excess oil. Flavourings were added (salt, pepper, chilli powder, e.t.c) if desired (Bond, 2014). Potato chips were packaged as soon as they were cool. Packaging was air tight and moisture proof. When packaged and stored correctly (in a cool place, out of direct sunlight and away from strong aromas), potato crisps ha ve a storage life of about 6 months (Habtamu, *et al.*, 2016). Finished products from the ten varieties were each labeled according to name of variety.

RESULTS AND DISCUSSION

EMERGENCE COUNT

The ranked mean for selected potato cultivars for emergence count, plant height and number of leafs studied are presented in Table 1. All the characters showed significant difference at ($p<0.05$) level of significance. For emergence count SP, Caruso and Marabel had the highest mean value 19.33 respectively followed by Condor of 19.00 mean value, then yellow and Nicola had 17.67 mean each,

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while Delice and Madola had 16.33 mean value and the least was China Var which had 13.00 mean value. SP, Caruso and Marabel proved to be a good cultivar in terms of emergence count after planting among the selected cultivars studied. The comparative performance of the selected potato varieties is a clear indication of the agronomics superiority of the varieties over others. Emergence count of the potato varieties determines the plant population per M^2 and when properly managed, the total tuber number and total tuber weight will provide maximum yield that will used for crisps and fries.

PLANT HEIGHT

The highest mean on plant height was observed in the variety Famosa with (44.60), followed by China Var (39.80), Mandola (39.18), yellow (35.47), SP (34.56), Marabel (31.40), Nicola (31.20), Condor (26.60) and the least was Delice which had 22.53cm mean value. The mean value performance of plant height showed significantly difference according to Duncan multiple range test (DMRT) at $P<0.05$ level of significance (Table 1). The variations in the plant height show that plant height is highly influenced by environmental factors like nutrient status of the soil, available moisture and weather radiation. Gopal (2007) reported no significant association between plant height and tuber yield. This result shows a little existence of association between plant height and total tuber yield.

NUMBER OF LEAVES

Table 1 show the number of leaves of some varieties of potato grown in Jos in 2018. The highest mean number of leaves of 639.10 was observed in China Var followed by Caruso which had 315.60 mean values, Marable had 274.80, condor (241.7), Mandola (237.10), Nicola (222.10), Famosa (193.60), SP (160.5) and the least was recorded by Delice which had 94.90 mean values. China Var proved to be a good cultivar in terms of number of leaves. This indicates that number of leaf initiated by a varieties influenced by the

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growing conditions. Tekalisgn and Hammes (2005) observed a considerable variation of number of leafs among the ten (10) selected potato varieties indicating that there was difference in the number of leaves initiated during plant development.

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TABLE 1: Mean performance of morphorlogical traits traits (Emergence count, Plant height and Number of leaves) in selected Potato cultivars grown in Kuru, Plateau state during the 2022 cropping season

S/NO	CULTIVARS	EMERGENCE COUNT	PLANT HEIGHT (CM)	NUMBER OF LEAVES
1	SP	19.33[a]	34.5[abc]	160.50[b]
2	CONDOR	19.00[a]	26.60[cd]	241.70[ab]
3	YELLOW	17.67[a]	35.47[abc]	380.60[ab]
4	FAMOSA	17.00[a]	44.60[a]	193.60[ab]
5	CHINA	13.00[b]	39.80	639.10[a]
6	DELICE	16.33[ab]	22.53[d]	94.90[b]
7	MANDOLA	16.33[ab]	39.13[ab]	237.10[ab]
8	CARUSO	19.33[a]	44.20[a]	315.60[ab]
9	MARABEL	19.33[a]	31.40[bcd]	274.80[ab]
10	NICOLA	17.67	31.20[bcd]	222.10[ab]
	Cv (%)	**11.90**	**17.68**	**85.74**

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Means in the some column with the same letters are not statistically significant at (P<0.05) level of significance according to Duncan multiple range test (DMRT)

INTERNODE LENGTH

The ranked mean values of selected quality traits of Potato cultivars for internode length, stem count at 6 WAP and stem girth are presented in Table 2. For internode length, SP and Fomosa showed significance different at P<0.05 level of significance, SP was the highest followed by Marabel which had 4.59 mean value then Caruso (3.97), Condor (3.83), Mandola (3.76), Condor (3.83), China Var (3.63), Famosa (3.56), Nicola (3.31), Yellow (3.28) and the least was Delice which had 2.59 mean values. SP exhibited the highest mean value among them and was statistically different from Delice and the rest of the selected cultivars in terms of internode length. Differential internode length of the selected potato varieties may be due to their inherent character in separate study Lynch and Rowberry (1977) observed in internodes development at highest fertility levels and wider spacing.

STEM COUNT AT 6 WAP

Table 2 shows the stem count of some varieties of potato grown in Jos in 2018 after six (6) weeks of planting (WAP). The Nicola showed the highest mean value (3.67), followed by Yellow which had (2.75) mean value, then Famosa with (2.53) mean value, for Condor and marabel had the same mean values of (2.40) while Delice, Mandola and Caruso had the same mean values of (2.00) each and the least was recorded by China var which had (1.27) mean value as presented in table 2. Nicola exhibited the highest mean values among them and was statistically different from them (P<0.05). The stem count was significantly affected by the growing environment and was influenced by plant density or level of fertilization.

STEM GIRTH

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The mean performance of stem girth on selected potato cultivars for crisps and fries grown in Jos in 2018 are presented in Table 2. China var showed the highest mean values of 4.25 followed by Marabel that exhibited 4.12 mean values, then Caruso which had 3.83 mean values, Mandola (2.99), Famosa (2.77) SP (2.74), Condor (2.71), Yellow (2.65), Nicola (2.61) and the least was recorded by Delice which 2.23 mean values according to Duncan multiple range test (DMRT) at $P<0.05)\$ level of significance. China var and Marabel proved to be good cultivars in terms of stem girth (diameter) and was statistically different from others. This showed that the stem girth is influenced by the growing environments. Wider intra row are influenced by the growing environments. Wider intra row spacing resulted in less competition among plants, availability of resources; high light interception and large quantity of photo assimilate production as well as assimilation and thus, increase plant growth and development ultimately increased in stem diameter. In line with the current findings, Dennis, *et al.*, (1994) also confirmed that increased intra-row spacing resulted in stem diameter.

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TABLE 2: Mean performance of morphological traits (internode, length, stem count at 6 WAP and stem girth) in selected Potato cultivars grown in Kuru, Plateau state during the 2022 cropping season

S/NO	Cultivar	Internode length	Stem count at 6 WAP	Stem girth
1	SP	4.83a	2.60b	2.74
2	CONDOR	3.83ab	2.40b	2.71c
3	YELLOW	3.28ab	2.75b	2.65c
4	FAMOSA	3.56a	2.53b	2.77c
5	CHINA	3.63a	1.27c	4.25a
6	DELICE	2.59b	2.00bc	2.23c
7	MANDOLA	3.76ab	2.00bc	3.83ab
8	CARUSO	3.97ab	2.00bc	3.83ab
9	MARABEL	4.59a	2.40b	4.12a
10	NICOLA	3.31ab	3.67a	2.61c
	CV (%)	**11.90**	**17.68**	

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Means in the some column with the same letters are not statistically significant at (P<0.05) level of significance according to Duncan multiple range test (DMRT)

TOTAL TUBER WEIGHT

The ranked mean value of total tuber weight on selected potato cultivars for crisps and fries grown in Jos in 2018 are presented in Table 3. China Var shows the highest mean values (4.77), then Caruso had (3.33) mean values, Condor (3.30) mean values, Famosa had (1.80) mean values, Nicola (1.77), SP (0.81) and the least was exhibited by Mandola with (0.53). These results suggest that fresh tuber yield in the potato is dependent not only on the number of tubers per plant but also on the tuber size and mean tuber weight.

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TABLE 3: Mean performance of total tuber number and tuber weight in selected potato cultivars grown in Kuru, Plateau during 2022 cropping season

S/NP	Cultivars	Number of tubers	Weight of tubers
1	SP	41.33^{d}	0.81^{c}
2	CONDOR	115.00^{a}	3.30^{b}
3	YELLOW	43.33^{d}	1.73^{c}
4	FAMOSA	50.00^{cd}	1.80^{c}
5	CHINE VAR	72.67^{bc}	4.77^{a}
6	DELICE	9.67^{e}	0.53^{c}
7	MANDOLA	30.33^{de}	1.63^{c}
8	CARUSO	72.67^{bc}	3.33^{b}
9	MARABEL	99.00^{ab}	4.37^{ab}
10	NICOLA	75.00^{bc}	1.77^{c}

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CV (%)	**25.75**	**28.14**

Means in the same column with the same letters are not statistically significant at (P≤ 0.05) level of significant according to Duncan Multiple Range Test (DMRT).

TOTAL TUBER NUMBER (t/ha^{-1})

The mean performance of total tuber number on selected potato cultivars for crisps and fries grown in Kuru, Plateau state in 2022 are presented in Table 3. Condor exhibited the highest mean total tuber number of (155.0), followed by Marabel which had (99.0) mean values, then Nicola that had (75.00) mean values, China Var and Caruso had the same mean values of total tuber numbers (72.67) respectively. Famosa had (50.00) mean values, Yellow (43.33), SP (41.33), Mandola had (30.33) mean values and the least was recorded by Delice which had (9.67) mean values. In terms of total tuber number, Condor, China Var, Marabel, Nicola, Caruso and Famosa exhibited the Highest mean values among the selected potato varieties and were statistically different from them. If for instance, if the objective is to produce large number of tuber and size Condor, China Var, Marabel, Nicola and Caruso could bring about the desired goal. This shows that the wider spacing there could be minimum competition among plants for space and resources and also better plant exposure for high radiation interception that increased the photosynthesis efficiency of the plant and finally resulting into increased number of tubers per plant.

DRY MATTER CONTENT

Clean, dry, standard size aluminum foil boats were as crucibles. Sliced samples, 3mm thin (10g) of each potato clone were weighed in the foil boat, and the initial weight measured in grams. The samples were dried in an electric oven overnight for 16h at 100^{o}C to a constant weight. The total solid content of each clone (varieties) was calculated as percentages are presented in Table 4. For Yellow exhibited the highest percent of dry matter content of 29.90%, followed by Condor which had 29.00% dry matter, then SP which had 25.30%, dry matter, Caruso had 30.93% dry matter, Famosa 27.73%, Marabel 30.43%, Delice 21.50%, Nicola 30.43%, Mandola had

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26.93% and the least was exhibited by China Var with 28.33% dry matter content. Higher dry matter or soil solids result in higher recovery of the processed products, lower oil absorption, less energy consumption, and crisps texture (Marwaha, *et al.,* 2005; Marwaha *et al.,* 2008).

SPECIFIC GRAVITY

Five (80-130g) tubers from each potato clone (varieties) were weight in air and in water tubers were all weight matched to ensure uniformity per cultivars. Average underwater weights were used to calculate the specific gravity as presented in table 4. The potato varieties varied with respect to specific gravity from 1.21 to 1.87. Five varieties performed better which are Delice, Caruso, Marabel, Condor and Yellow which had 1.87, 1.46, 1.45, 1.43, 1.43 respectively for Nicola, SP, Famosa, Mandola and China Var had 1.42, 1.34, 1.40, 1.37, 1.21 of specific gravity respectively. The observed difference in specific gravity may be mainly due to genetic constitutions, since all the cultivars were grown and tested in one location with similar management. The observed differences in specific gravity among potato clones may be mainly due to genetic constitution, since all varieties were grown and tested in one location with similar management.

ABSORPTION RATE

Table 4 show the absorption rate of some varieties of potato grown in Kuru, Plateau state during the 2022 cropping seasons. Chips weight after frying of Caruso and China Var was significantly high with (37.50%) absorption rate respectively followed by Famosa and Nicola varieties which had (35%) absorption rate after frying, then Marabel which had (32.5%) absorption, Yellow and Condor had the same absorption rate of (30%) while SP had (29.41%) absorption rate, Mandola had (27.5%) and the least was recorded by Delice which had (25%) absorption rate (weight after frying).

RANKING IN FRYING COLOUR

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Table 4 show the ranking in colour during frying of some varieties of potato grown in Kuru, Plateau state during the 2022 cropping season. SP and Delice exhibited pale Yellow in colour while Yellow and Mandola showed very pale yellow in colour ranking for Famosa and Marabel exhibited brown in colour while China Var and Caruso showed cream in frying colour, however, Condor showed pale cream till date in frying colour ranking and Nicola exhibited Dark brown colour during frying. Lisinka *et al*., (2007) reported that potato when sliced and fried, show different colours. This attributes is considered the most important in fried potato quality. Moreover, this characteristic is essential for consumers' acceptance. According to Tocchini and Mercadante (2001), in food evaluation, the visual impact caused by its colour overlaps other attributes, highlighting that this features is one of the most important for products commercialization being the first criterion for production acceptance and rejection.

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TABLE 4: Mean of quality traits, Dry matter content, specific gravity, absorption rate and ranking in fry colour of selected potato cultivars grown in Kuru during 2022 cropping season

S/NP	Cultivars	Total tuber (tha^{-1})	Dry matter (%)	Specific gravity	Absorption rate (%)	Ranking in fry colour
1	SP	5.81^{c}	25.36	1.34±0.174	29.41	Pale yellow
2	CONDOR	8.30^{b}	29.00	1.43±0.186	30.00	Pale cream till date
3	YELLOW	6.73^{c}	29.90	1.43±0.186	30.00	Very pale yellow
4	FAMOSA	6.80^{c}	27.73	1.40±0.182	35.00	Brown
5	CHINE VAR	9.77^{a}	28.33	1.21±0.157	37.50	Cream
6	DELICE	5.53^{c}	21.50	1.87±0.243	25.00	Pale yellow
7	MANDOLA	6.63^{c}	26.93	1.37±0.178	27.50	Very yellow
8	CARUSO	8.33^{b}	30.93	1.46±0.190	37.50	Cream
9	MARABEL	9.37^{ab}	30.43	1.45±0.189	32.50	Brown

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10	NICOLA	6.77[c]	30.43	1.42±0.185	35.00	Dark brown
	CV (%)	**9.14**	**-**	**-**	**-**	**-**

Means in the same column with the same letters are not statistically significant at (P≤ 0.05) level of significant according to Duncan Multiple Range Test (DMRT).

AFTER COOKING BLACKENING

For selecting of quality processing of potato varieties for crisps and fries in regard to after cooking blackening are presented in Table5. Tubers are cooked and peeled, the colour change assessed after 24 hours. Scale 1-9 assessment were used for SP and Condor varieties are trace too little after cooking blackening while Caruso showed none blackening after cooking and Delice, Mandola, Marabel and Nicola varieties showed some blackening after cooking. The colour change may occur as a result of damaged cells, enzymes and substrate mixed initiating all kinds of reactions. There are also reactions that cause brown and grey discolourations, due to the formation of a type of enzyme that affects tissue colour (NIVAA, 2002).

TEXTURE FIRMNESS

The firmness or softness of the cooked flesh was assessed by slowly pushing a fork down into the centre of the tuber. Texture firmness was assessed as presented in Table 5 from the results obtained, SP, Condor, Yellow, China Var, Caruso and Nicola showed a mealy texture of the cooked flesh, while Famosa and Marabel are rather mealy texture firmness of the cooked flesh for Delice and Mandola had rather strong texture of the cooked flesh varieties among the selected potato cultivars. Texture is influenced by starch content (Van Marke *et al.,* 1997). Pandey *et al.,* (2004), evaluated that the texture of fries were affected by dry matter and reducing sugar content. Potatoes having more dry matter show mealiness when processed (Mehdi, *et al.,* 2008).

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FLAVOUR

Each tuber was tasted and each person assessed the potato flavor as expressed in Table 5. Condor, Caruso and Nicola are expressed as Moderate in terms of flavor, while SP, Yellow, Mandola and Marabel showed moderately good in flavour than the above cultivars. For China Var and Delice had a good flavour of cooked tubers and peeled. This could be due to their dry matter content which is in between 25.30% to 30.93% which fulfilled the criteria for chips processing and the vegetable oil used (Dagne and Tigist, 2017). This study implies that potatoes with high dry matter content and specific gravity produces acceptable flavor of potato chips and fries. Smith (1987) reported that chips and fries possess flavours inherent in the raw potato as changed by high temperature for a short time.

COOKIN G TYPE (STRUCTURE)

The cultivars and clones are grouped for cooking type as presented in Table 5. In terms of cooking types, SP, Yellow, Delice and Caruso showed mealy cooking type while Condor, Famosa, China Var, Mandola and Nicola varieties showed soft cooking type. However, only Marabel showed rather soft cooking types as expressed in Table 5. Results obtained showed that varieties with soft cooking ty pe are suitable for eating boiled, frying mashing and fresh and conserve potato consumption. Hassan Panah, *et al*., (2011) stated that the potatoes of this types mealy, their surface are dull and does not disintegrate or only to some extent, he further intimated that they rather firm, slightly humid or rather dry and must be fine.

BITTERNESS

The interaction of varieties and growing environment does not influence the bitterness of potato crisps and fries for ten (10) selected potato varieties indicated that none of varieties tasted bitter for potato crisps and fries as expressed in Table 5. Bitterness of potato

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crisps and fries was presented in Table 9. All the 10 (ten) potato varieties are rated not bitter, this may indicate that at harvest bitterness of potato chips and fries are very low as compared to potatoes which were stored before processing. Asmamaw, *et al*., (2010) showed that the loss in taste of chips, crisps and fries during storage may be due to the increase in the concentration of glykoalkaloids level of tubers.

SOURNESS

The growing environment, varieties and interaction did not influence the sourness of the crisps and fries. Potato crisps and fries prepared from the tubers harvested from the 10 (ten) selected potato varieties indicated none sourness (not sour) of the crisps and fries as showed in Table 5. Sourness may be due to the presence of very low or absence of sourness taste in the potato chips when fried after harvesting. Grebramedhin, *et al*., (2013) also reported that after harvesting crisps and fries from most of the varieties were very much liked by the panelists, while during the storage period there was a progressive loss of taste of crisps and fries.

SWEETNESS

The effect of location, environment and varieties influenced the sweetness of potato crisps and fries as presented in Table 5. In general potato and fries appeared to result sweeter in Delice, Caruso and Marabel as compared to the other seven varieties (i.e. SP, Condor, Yellow, Famosa, China Var, Mandola and Nicola) that are not sweet.

CRISPINESS

The growing environment and varieties has influenced the crispiness of potato crisps and fries (Table 5) for SP, Yellow, Delice and Mandola varieties produced very crispy potato chips and fries, while Condor, Famosa, Caruso, Marabel and Nicola varieties produced less crispy potato to crisps and fries. However, only China Var produced or had no crispiness in potato crisps and fries (Table 5). This is strongly linked to the difference in tuber dry matter of the selected potato varieties grown in Jos during the 2018 cropping season. The result indicated that the dry matter content of the varieties influences the crispiness of the chips and fries. Lisinska (1998) and

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Leszynski (2006) established that potato tubers, chips obtained from potato rich in dry matter above 25% can exhibit hard textures whereas crispiness of chips made from potatoes with low dry matter are characterized by greasy and sticky textures (Linsinska, 1998).

TABLE 5: Ranking in Potato crisps and fries of selected potato cultivars grown in Kuru, Plateau state during the 2022 cropping season

S/NP	Cultivars	Disintegration	After cooking blackening	Texture firmness	Flavor	Cooking type	Sensory evaluation	Bitterness	Sourness	Crispiness	Ssweetness
1	SP	Slight	Trace to little	Mealy	Moderate to good	Mealy	Neutral	Not bitter	Not sour	Very crispy	Not sweet
2	CONDOR	None	Trace to little	Mealy	Moderate	Soft	Neutral	Not bitter	Not sour	Less crispy	Not sweet
3	YELLOW	Moderate	Little to some	Mealy	Moderate to good	Mealy	Neutral	Not bitter	Not sour	Very crispy	Not sweet
4	FAMOSA	Slight	None	Rather mealy	Good	Soft	Neutral	Not bitter	Not sour	Less crispy	Not sweet

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5	CHINE VAR	None	None	Mealy	Good	Soft	Neutral	Not bitter	Not sour	Not crispy	Not sweet
6	DELICE	None	Some	Rather strong	Good	Mealy	Neutral	Not bitter	Not sour	Very crispy	Not sweet
7	MANDOLA	Slight	Some	Rather strong	Moderate to good	Soft	Neutral	Not bitter	Not sour	Very crispy	Not sweet
8	CARUSO	Moderate	None	Mealy	Moderate	Mealy	Neutral	Not bitter	Not sour	Less crispy	Not sweet
9	MARABEL	Slight	Some	Rather mealy	Moderate to good	Rather soft	Neutral	Not bitter	Not sour	Less crispy	Not sweet
10	NICOLA	Slight	Some	Mealy	Moderate	Soft	Neutral	Not bitter	Not sour	Less crispy	Not sweet

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Conclusion

The results of this study show that the emergence count, plant height, number of leaves, internode length, stem count at 6 weeks after planting (WAP), stem girth, total tuber weight, total tuber number, dry matter content, specific gravity, tuber yield, absorption rate, flavour and taste, and sensory properties of crisps and fries. Varieties Caruso, Marable, Nicola, Yellow, Condor and China var were suitable for processing into potato crisps and fries. Marable, Nicola, Caruso, Condor, China var and Famosa were, however, most suitable and could be promoted for commercial use by the potato industry. Yellow, SP, Delice and Mandola that is known to be moderately high yielding can produce equally good quality crisps and fries and should be promoted alongside condor, Famosa, Caruso, Marable and Nicola that is the variety available currently to many crisps and fries processor in Jos, Plateau State, Nigeria.

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